Producing a Non-dendritic Structure Metal by Using Rheocasting Method for Developing The Semisolid Forming Process in Order to Improve a Conventional Casting Process

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Abstract

This work was conducted to produce non-dendritic (globular) structure semisolid metal. It was related to long term objective of the research to apply semisolid forming technology for producing automotive component. Technology for semisolid forming involves preparation of globular structure of semisolid metal and transfering directly into a die for component shaping. Semisolid forming technology gives opportunity to produce automotive component with high integrity and tight dimensional control.

Material processed in this study was Al-6,23% Si alloy. In this research, globular stucture was obtained by mechanical stirring of molten metal during solidification. Rotating rod stirred the melt for short periods and then removed. The rod cools the alloy below its liquidus temperature to intiate solidification while stirring the melt. Process parameters of rheocasting that investigated were preheat temperature of stirring rod (200 ^{o}C, 300 ^{o}C, 400 ^{o}C and 500 ^{o}C), stirring depth (30 mm, 40 mm, 50 mm and 60 mm) and stirring rod material (cupper, carbon steel and graphite). Microstructure of rheocasting result was examined to obtain value of grain shape factor. Shape factor is used to quantify grain sphericity. Shape factor is 1 refers to a perfectly spherical (globular) morphology, while shape factor = 0 refers to complex shape.

The work result shows that the rheocaster machine able to produce globular semisolid metal with shape factor value above 0.58. Shape factor value and grain size increases with increasing of preheat temperature of stirring rod. The highest shape factor 0,7 was obtained at preheat temperature 500 ^{o}C. At preheat temperature 400 ^{o}C, depth of stirring rod was not found to have siginificant effect on spherecity of primary α grain. Increasing of depth of stirring rod from 30 mm to 60 mm slightly increased shape factor from 0.64 to 0.68. Stirring rod material also was

not found to have significant effect on spherecity of primary α grain. Graphite rod produced shape factor 0,66 and cupper rod produced shape factor 0,62. At stirring depth of steel rod 50 mm, rotation speed 200 rpm and preheat temperature 440 ^{o}C – 470 ^{o}C, rheocasting produced globular structure of semisolid metal that could be casted by conventional casting.

Keywords : *rheocasting, globular structure, semisolid metal, stirring*